of surrounding land has not accompanied the withdrawal of vast volumes of water from the deep wells at Deptford, Thames Head, Caterham, Canterbury, Watford, Tring, or Lichfield, and it is singular that Mr. Evans should have overlooked the fact that moisture is supplied to growing plants from above and not from below. However numerous the wells of a given district may be, the rain must still fall upon the surface of, and soak through, the land before it can reach them.

As the *dry-weather* flow of the Thames even above Teddington lock is 600 millions of gallons daily, it would be waste of time to discuss seriously the possibility of canals and navigable rivers sinking into their beds in consequence of the abstraction of about one-eighth of that volume from springs and deep wells in that portion of the river basin. With regard to the water-cress interest, it is true that the Rivers Commissioners have not been so deeply impressed as Mr. Evans with the stupendous importance of this department of Thames agriculture, but it can scarcely be doubted that a wealthy city, containing 4,000,000 of inhabitants, would be able and willing to pay for any damage which it might inflict upon this or any other branch of industry.

The two most disgusting impurities revealed by the microscope in Thames water, as delivered for dietetic purposes in London, are the fibres of partially digested flesh meat, and those of variously coloured rags. The presence of these objects in our potable water clearly indicates the two chief kinds of *insoluble* polluting matter cast into the Thames, although chemical analysis cannot always trace to its sources the *dissolved* animal and vegetable impurities which it finds accompanying these insoluble materials. The question raised, therefore, is simple enough :—Shall the inhabitants of this "overgrown city," as Mr Evans contemptuously terms it, drink the pure spring water which nature offers them in singular abundance in the Thames valley, or shall they not be permitted to taste this sparkling beverage until the paper manufacturers, in the exercise of what they call their rights, have washed their filthy rags in it, and half a million of people have polluted it by their drainage?

It is remarkable that whilst Mr. Evans shows so much consideration, in his presidential address, for the pockets of the watercress-growers, he has so little to bestow upon the inhabitants of the overgrown city, for he does not hesitate to propose that the latter should encounter the expense of two separate water services—one (pure) for dietetic, and a second (polluted) for other domestic purposes. Now, leaving out of consideration altogether the risk of the polluted water being often used for dietetic purposes instead of the pure, and the enormous cost and inconvenience of laying and maintaining a new set of water-mains throughout the hundreds of miles of London streets ; the supply of each house with a new water service, together with the necessary alterations of the old pipes, could not cost, on the average, less than 4*l*. In February last 523,801 houses were supplied with water by the eight metropolitan companies, and we have consequently here an expense of more than 2,000,000*l*. Surely a very small fraction of this sum would suffice to buy up any injured watercress-growers, even at "fabulous" prices.

In their sixth report, the Rivers Commissioners of 1868 state that the basin of the Thames, including that of its tributary, the Lea, is upwards of 5,000 square miles in extent. Rather more than one half of this area, including the oolitic and cretaceous formations, is covered by a porous soil upon a permeable water-bearing stratum, the remainder being occupied by the Oxford, Kimmeridge, gault, and London clays. The annual rainfall of this district averages about 28 inches, or 5,217 millions of gallons per day. Two-thirds of this vast volume of water is lost by evaporation, while, of the remaining one-third, one-half passes away in floods, and the other half only is at present available for springs and deep wells. But even this small fraction amounts to 870 millions of gallons daily, and it is proposed to take for the supply of the metropolis only 120 millions of gallons after it has practically performed all its fertilising functions ; whilst, of this volume, there is even now supplied to London, in dry weather, about twenty-two millions of gallons. It is highly probable, however, that the volume of water available at present for springs and deep wells could be augmented to an extent commensurate, or nearly so, with the amount so abstracted for the supply of London. The chalk, and to some extent the oolite of the Thames basin, constitute an immense sponge which sops up the water falling upon it and maintains it, partly by capillary attraction and partly by its resistance to flow, at considerable elevations above the nearest rivers. This sponge has been aptly likened by Mr. Thornhill Harrison to an inverted reservoir, and just as the dry-weather flow of the Thames and its tributaries could be augmented by the judicious use of artificial storage reservoirs, so could the total yield of spring water from this vast natural reservoir be increased, by artificially bringing the water in it to a lower level before the occurrence of the autumn and winter floods. The spongy reservoir would thus be rendered capable of receiving those heavy rainfalls which, at present unable to find storage room below, either run off the saturated surface and constitute the winter floods, or immediately displace a corresponding volume of spring water from the sponge forcing it into the Thames and its affluents.

In the concluding paragraphs of his address Mr. Evans tries to show, from the results of chemical analysis, that the polluted water of the Thames is purer than the spring water from the chalk, and he thus seeks to make the inhabitants of the metropolis content with their present supply. His statements on this subject are founded upon an entire misconception of the meaning of the analytical results. A most exhaustive chemical examination of the river waters of the Thames basin, on the one hand, and of the spring and deep-well waters on the other, has shown, in the most unmistakable manner, the immense superiority of the latter for dietetic purposes. Indeed, it is obvious that, even with the most efficient river conservancy imaginable, aided by the best efforts of the Legislature, the Thames must always receive so much pollution as to render its use for the supply of the metropolis highly objectionable. No preventive measures can hinder the washings of highly-manured land, the excrements of cattle, the imperfectly purified sewage of towns and villages, and the partially cleansed discharges from paper-mills, skinneries, and tanyards, from mingling with the stream in enormous volumes. Such matters, though not obviously offensive to the senses (when this highest practical stage of purification has been reached), are still, from a sanitary point of view, of a very dangerous character. But even if this were not so, and if fatal results had never been known to follow the domestic use of such water, the refined feeling which separates the civilised man from the savage, and which excites loathing at the bare idea of organic matter, which has recently formed part of a human body, being supplied for human consumption, ought here to assert itself, and secure the rejection of such a beverage.

E. FRANKLAND

SCIENTIFIC NOTES TAKEN IN THE HIMALAYAS

I.—*Atmospheric Absorption.*

THE following notes refer chiefly to spectroscopic work, and they are, I think, of interest, as they show the importance of establishing a regular series of similar observations at different points of the globe.

Prof. Vogel has lately published in Poggendorff's *Annalen* the results of his observations taken in the Red Sea and in the Indian Ocean. He comes to the

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conclusion that the relative intensity of the blue and red end of the solar spectrum is subject to great variations, variations which do not seem to stand in a simple relation to the hygroscopic state of the atmosphere or to barometric pressure. My results, while entirely confirmatory of those of Vogel, point to the fact that in the higher regions of the Himalayas, and at the season the observations were made, atmospheric absorption takes place chiefly in the red end of the spectrum. The blue end of the solar spectrum, even when the light of the sun has passed through a cloud, is remarkably bright.

The following extract from my note-book will place this fact beyond doubt. The observations were conducted at Simla with a spectroscope of eight prisms of about 60°. The direct sunlight was reflected by means of a small mirror into the slit. The slit was generally adjusted until one line between D_1 and D_2 was distinctly seen. As far as I could judge, all the lines, but not more than those given in Angström's map, were seen. The rainy season had just begun, but had not yet appeared in the violent way it did after my departure from Simla:—

Extract from Note-book.

June 27, 8 A.M.—B beautifully shaded. Light visible in the blue as far as wave-length 4040, and most likely further, but the telescope cannot be moved to greater deviation.

9 A.M.—Space beyond B closes up, while in the blue the spectrum is as visible as before.

Red end closes up. Blue perfectly visible.

11.15 A.M.—The red closed up still more. The blue as clear as before.

The sky is beautifully blue, but a slight halo seen round the sun.

July 3, 5.30 P.M.—The atmospheric lines near D seen distinctly. The blue is exceptionally clear and visible as far as H. Sky rather cloudy, and halo round the sun.

6.30 P.M.—Sun very near horizon. Spectrum seen from C to G.

In judging on the visibility of the spectrum, it should be borne in mind that, owing to the great number of prisms, a great part of the absorption in the blue was due to the glass, and that, therefore, owing to the great dispersion in the blue and instrumental absorption, the blue was seen under peculiar disadvantage. The above are only a few out of many observations. I have observed the passage of a cloud in front of the sun without any apparent effect in the blue, while the red end was all cut off.

I was at the same time struck by the fact that the peculiar redness of the clouds in the evening, which we observe so often in our climates, was only rarely seen, and when seen the colour was rather yellow than red. On making this remark to a friend competent to judge, and who through a repeated sojourn in Simla was enabled to form an opinion, I heard that the redness of the sky at sunset was often and beautifully seen at the end of, and after the rainy season.

I now pass to a few observations which I have made in Upper Thibet, a country which lies beyond the range of the rainy season. The observations all point to the remarkable clearness in the blue. As I have said, the hygroscopic state of atmosphere, as measured by the wet and dry bulb or barometric pressure, cannot alone account for all the phenomena. I find, for instance, that the presence of vegetation affects the atmospheric absorption in a remarkable degree. In the Kyan Chu plain, for instance, the plateau on which I observed the mirage described in NATURE (vol. xiii. p. 67), objects at ten miles distance look as sharp and distinct as those half a mile off. It is, in fact, impossible to judge of distance. Crossing the Tagalung Pass (18,000 feet), we descended from that plain into the valley of the Indus. As soon as we reached vegetation, at a distance of only two marches from the above-mentioned plain, and at height still above 12,000 feet, the whole aspect of the country is a different one. Distant mountains now take that lofty blue colour which gives such peculiar charm to the landscape. In the evenings especially you cannot help knowing that there is something between your eye and a distant object which affects its colour and distinctness, and through it you get a standard for judging distances. Without vegetation, even at a lower height, as, for instance, in the valley of the Bagha (Lahoul), you seem to look through a vacuum. In the upper part of the valley of the Indus, of which I am now speaking, I have not seen that clearness in the atmosphere which I have invariably seen in Switzerland at a height of 3,000 feet. The strong radiating power of the sun, which stands much more vertical in India, is evidently the cause of this, for it can only be organic matter floating in the atmosphere which can produce such a striking result. That the absence of any rain or deposit of any kind must not be left out of account is clear. The air in the side valleys of Cashmere, although rich in vegetation, is particularly transparent. Strange enough the principal valley of Cashmere, *i.e.* the valley of the Jehlum, is generally hazy, although there is a good deal of rain.

I have seen the planet Mars look almost white; Jupiter and the other stars at that time had a bluish tint.

II.—*Glaciers.*

On the maps of Upper Thibet one finds a great many glaciers marked down. From my knowledge of glaciers I would not have given to these frozen masses of snow the name of glaciers. On inquiring further into the matter, I find that from measurements made by Schlagintweit these so-called glaciers have only very little, if any motion; and judging from what I have seen and heard, I should say they must be only half-formed glaciers. The cause of this seems to me to be the want of pressure above the glaciers. In a country where the snow line is 19,000 feet high, and in which the mountains are seldom over 21,000 feet—for such is the country I am talking of—there cannot be a sufficient pressure to convert the snow into a clear mass of ice. I am however told that there is in Spiti one, but only one, glacier which deserves the name.

III.—*Temperature of the Blood.*

I am sorry that my observations on the temperature of the blood were cut short by untimely breakage of the thermometers. I have taken, however, a few observations in the plains of India, when the temperature of the air was higher than that of the blood. In a temperature of about 100° the blood was little above 98°.

IV.—*Parhelia.*

According to received opinions, parhelia are due to the refraction of light through crystals of ice. If this explanation is correct, and there seems to be no reason to doubt it, the following observations are of interest, as they show that even at the equator ice-clouds exist, and that parhelia are more often seen in India than in England. I have only once been lucky enough to see a parhelion in England, and that was since my return from India. In tropics and in the Himalayas I have seen within four months, eight times a rainbow-coloured ring round the sun. Its distance from the sun could only be measured by rough means, but it seemed to me to be larger than the generally given value of 22°, although near it. I subjoin the various observations:—

1. May 3.—Near Singapore, about sixty miles north of equator, at 5 o'clock P.M., part of a rainbow-coloured ring was seen, with the sun as centre. It stood on the white edge of a dark cloud.

2. Aug. 1.—At Dwara, in the Kulu Valley, almost the exact reproduction of the above phenomenon was seen on a cloud hanging on the side of a mountain. It was during the rainy season, at a height of about 5,000 feet. Weather rather hot.

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3. Aug. 3.—Near the top of the Rotang Pass (13,000′), about 9 o'clock A.M., the lower half of a beautifully-coloured ring was seen for about half an hour.

4. Aug. 5.—Gondla (10,000′). At 3 P.M. a beautifully-coloured ring round the sun was seen on a very thin film of clouds in front of the sun. The blue was most distinct, and much purer than in the common rainbow.

5. Sept. 19.—While going down the Jehlum in a boat from Islamabad to Srinagur, I saw in the river the reflection of part of a coloured ring. Looking directly at the cloud, I saw the ring again on the white edge of a cloud. The sun was nearly setting.

6. Sept. 23.—At Baramula, at 4 P.M., I saw the same ring described above most distinctly, and making a complete circle round the sun.

7.—Marching out of Cashmere I was struck one morning by the appearance of the cloud being nearly the same as when I had before seen the circle in question. On looking carefully I could indeed see a faint trace of the ring.

8. Oct. 6.—At Peshawur (Punjab) I saw to the right of the setting sun about the sixth part of the coloured ring.

ARTHUR SCHUSTER

VISIT OF THE CHEMICAL SOCIETY TO THE ROYAL ARSENAL

IN response to an invitation from its president, Prof. Abel, F.R.S., the chemist of the War Department, nearly 500 Fellows of the Chemical Society visited the Royal Arsenal at Woolwich on Tuesday last. The presidents of most of the learned societies, together with other eminent men of science, were included in Mr. Abel's liberal invitation, so that during the day a constant stream of visitors flowed through the interesting workshops at Woolwich.

Beyond the ordinary attractions of the establishment, Mr. Abel had arranged to demonstrate the more important applications of science to warfare, and among these were included some experiments with gun-cotton and other explosives, the study of which he has made peculiarly his own. Indeed, the most attractive part of the programme from a scientific point of view was that carried out on the outskirts of the arsenal in the vicinity of the proof butts, where operations commenced by the firing of the big 80-ton gun. Col. Younghusband, F.R.S., R.A., the Superintendent of the Royal Gun Factories, as well as other heads of departments, had entered warmly into the spirit of the visit, and took considerable pains that every opportunity should be given the Fellows of witnessing the capabilities of this monster weapon. A charge of 250 lbs. of gunpowder, the grains of which measured nearly two inches cube, was introduced into the gun, and then the heavy bolt, or projectile, weighing 1,260 lbs. was rammed home. Those who were privileged to enter the chronoscope room, which is so small unfortunately, that scarcely a score of visitors could find room in it, were gratified with a sight of Boulanger's instrument for calculating the velocity of a cannon-ball in its flight, and as the thundering discharge was heard, this delicate apparatus proclaimed, simultaneously, that the projectile had been sent on its way at a velocity of nearly 1,500 feet a second, an impetus, it is said, sufficient to make a hole through the *Inflexible* iron-clad, with her twenty inches of armour and thick teak backing. The Boulanger instrument is easily explained. Placed in front of the gun, at an interval apart, are two wire screens, so arranged that the projectile in its flight tears through them one after another. From two magnets attached to the instrument hang two metal rods, and the instant the first wire screen is torn by the shot, a current of electricity is broken and the first of these rods falls. As No. 1 is in the act of falling, however, the second wire screen is broken by the shot releasing No. 2 rod, and this sets in action a trigger which strikes No. 1 rod before it has yet completed its fall. If the shot has been slow in travelling from one screen to another, then rod No. 1 has, naturally enough, nearly fallen its entire length before it receives a stroke from the trigger; and the higher the mark is upon the rod No. 1, or in other words, the more it has fallen the less rapid has been the passage of the shot. After the mark is made one has merely to refer to a scale to get the velocity.

After the firing of the 80-ton gun came the gun-cotton programme, which Mr. Abel and Mr. E. O. Brown had arranged for the purpose of demonstrating in the first place the peculiar qualities of this explosive, and secondly its application to war purposes. To quote from this programme, Mr. Abel first gave "illustrations of some of the conditions which promote detonation of an explosive agent by a blow, or by the force exerted by an *initial* detonation." It was shown that gun-cotton refused to detonate except under very special circumstances, that is to say, neither a confined charge of gunpowder nor a small charge of unconfined mercuric fulminate brought about that result, which was only effected by a confined charge of fulminate, or by other masses of gun-cotton being detonated in its immediate vicinity.

Mr. Abel then went on to demonstrate the high speed at which detonation travels, the same being faster than any known agent, if we except electricity and light. A row of gun-cotton cakes half an inch apart, 36 feet long, was detonated at one end, and by crossing the row with several insulated wires connected with Noble's chronoscope (the wires being broken one after the other, as the detonation proceeded), it was proved that the velocity of the detonation exceeded 18,000 feet per second.

But it was the last of the gun-cotton experiments which proved the most interesting to the general body of visitors, as they illustrated the important uses of this valuable explosive. In these trials the gun-cotton was employed for the most part in a *wet*, and therefore *uninflammable* state, in which condition it detonates just as readily as when dry, provided a small charge of desiccated cotton is used to start the action. First of all, the value of detonation was shown in connection with cavalry raids in an enemy's country. Provided with a few pounds of gun-cotton and some fulminate fuses, a trooper might cut half-a-dozen lines of railway with very little ceremony, for, as Mr. Abel plainly showed, an eight ounce cake of the material exploded upon a rail, fractured the metals so completely as at once to block the line. In the demolition of wooden stockades, such as have caused us some difficulty in Perak lately, gun-cotton was shown to be equally efficacious, for a charge of wet cakes placed at the foot of such a structure on Tuesday last, levelled the same to the ground far more quickly than it takes to tell of the incident. Finally, a torpedo was fired under water constructed in the most primitive manner, by simply filling a large potato-net with gun-cotton slabs, and throwing it bodily into the water, a fuze and dry primer being contained in the middle of the charge.

After lunch, which the president had hospitably provided for his numerous guests, and at the close of which Dr. Hooker, C.B., P.R.S., took the opportunity of thanking Mr. Abel for the intellectual treat he had provided them with, the visitors had the satisfaction of witnessing the process of big gun making, a forging of fifty tons of glowing metal (the coil of one of the 80-ton guns) being worked under the monster 40-ton steam-hammer for their especial behoof.

The last sight of all was certainly not the least interesting. It was the run of a Whitehead torpedo under water, the machine, as our readers may know, being shaped in the form of a cigar and propelled through the water, rocket-fashion, by means of compressed air, which issues from its tail. The passage of this submarine monster the whole length of a canal, termed the torpedo

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